FULL CONTENTS

[Claim(s)]

[Claim 1]It is a protective film which laminates DLC (diamond like carbon) more than two-layer at least with a ground film on a substrate, A DLC layer stuck to said ground film formed in said substrate is formed by hydrogen part pressing down predetermined [that internal stress becomes small], A protective film characterized by what is formed under conditions in which at least one layer other than said DLC layer stuck to said ground film among said protective films does not contain substantially hydrogen that density becomes large.

[Claim 2]The protective film according to claim 1 characterized by what said predetermined hydrogen partial pressure is abbreviated 20%.

[Claim 3]A process of forming the 1st DLC layer stuck to said ground film which is a manufacturing method of a ground film and a protective film which laminates DLC more than two-layer on a substrate at least, and was formed in the (a) aforementioned board under conditions of 20% of hydrogen partial pressure abbreviation that internal stress becomes small, (b) A manufacturing method of a protective film including at least a process of forming hydrogen which becomes large [density] about the 2nd DLC layer under conditions which are not included substantially on said 1st DLC layer.

[Claim 4]In an organic EL device with which a protective film is formed on said glass substrate so that an anode, an organic electroluminescence (electro-luminescence) layer, and the negative pole may be laminated by this order on a glass substrate and these may be covered, An organic EL device characterized by what said protective film laminates DLC more than two-layer at least with a ground film which consists of amorphous silicone, and is constituted for.

[Claim 5]In an organic EL device with which a protective film is formed on said glass substrate so that an anode, an organic electroluminescence layer, and the negative pole may be laminated by this order on a glass substrate and these may be covered, Said protective film makes a ground film which consists of amorphous silicone, and structure which laminated DLC more than two-layer at least, An organic EL device characterized by what a layer stuck to said ground film formed in said glass substrate among protective films of said lamination structure is constituted by the 1st DLC layer with small internal stress, and at least one layer other than said 1st DLC layer is constituted for by the 2nd DLC layer with large density.

[Claim 6]The organic EL device according to claim 4 or 5 characterized by what thickness of said protective film is 10 nm or less.

[Claim 7]The organic EL device according to claim 4 to 6 characterized by a thing of said protective film for which the above is further formed with hydrogenation carbon at least.
[Claim 8]The organic EL device according to any one of claims 4 to 7 with which said 1st DLC layer is characterized by what is formed under conditions of 20% of hydrogen partial pressure abbreviation.
[Claim 9]The organic EL device according to any one of claims 4 to 8 characterized by what said 2nd DLC layer is formed for under conditions which do not contain hydrogen substantially.
[Claim 10]The organic EL device according to any one of claims 4 to 9 characterized by what said 1st DLC layer or the 2nd DLC layer is the film formed by a CVD method.
[Claim 11]The organic EL device according to any one of claims 4 to 9 characterized by what said 1st DLC layer or the 2nd DLC layer is the film formed of a sputtering method.
[Claim 12](a) A process of forming the 1st DLC layer under conditions of 20% of hydrogen partial pressure abbreviation that internal stress becomes small, after ground film formation which consists of amorphous silicone on a glass substrate in which an anode, an organic electroluminescence layer, and the negative pole were laminated by this order, (b) A manufacturing method of an organic EL device characterized by what a process of forming hydrogen that density becomes large about the 2nd DLC layer, under conditions which are not included substantially on said 1st DLC layer is included for at least.
[Claim 13]A manufacturing method of the organic EL device according to claim 12 characterized by what said 1st DLC layer or said 2nd DLC layer is formed for with a CVD method.
[Claim 14]A manufacturing method of the organic EL device according to claim 12 characterized by what said 1st DLC layer or said 2nd DLC layer is formed for by a sputtering method.
[Claim 15]An organic EL display carrying the organic EL device according to any one of claims 4 to 11.

[Detailed Description of the Invention]
[0001]
[Field of the Invention]Especially this invention relates to an organic EL device which has the protective film formed with hydrogenation carbon, and a manufacturing method for the same about an organic electroluminescence (electro-luminescence) element and a manufacturing method for the same.
[0002]
[Description of the Prior Art]In order to realize high-intensity-ization of an organic EL device conventionally, a material excellent in electronic pouring of alkaline metals etc. is used as a negative pole material, but on the other hand there is a problem that reactivity is high, between oxygen, moisture, etc. Although a high material of luminous efficiency is similarly used in organic electroluminescence material, chemicals degradation arises with oxygen and moisture in the atmosphere, and there is a possibility that luminescent property, such as luminosity and the degree of color, may fall.
[0003]Here, it explains, referring to Drawings for the conventional organic EL device. Drawing 5 is a sectional view of the conventional organic EL device. As shown in drawing 5, the conventional organic EL device is constituted by forming the anode (transparent electrode) 2 which consists of ITO(s) (indium tin oxidation thing) on the glass substrate 1, and forming the organic electroluminescence layer 3 and negative pole 4 grades, such as an electron hole pouring transportation layer, a luminous layer, and an electronic

pouring transportation layer, on this. The protective film 9 is made to cover here for the corrosion control of a cathode part and an organic electroluminescence layer.

[0004]Although protective films, such as SiO_2 and Si_3N_4, are made to cover with JP,H8-111286,A about this protective film, in order to make the life of an element hold for a long period of time, not less than 100 nm of protective film thickness is needed. In JP,H5-101885,A, the diamond Mr. thin film by the ionization vapor-depositing method for having more than Vickers hardness [of 3000-8000kg/mm] ^{2} is made to form in the organic electroluminescence layer surface, and the film thickness at this time is 0.5 micrometers or more. In JP,S63-259994,A, EL element is made to seal with the amorphous-like carbon film which consists of a carbon atom and a hydrogen atom, and the film thickness at this time supposes that several 10 nm - about several micrometers are suitable.

[0005]

[Problem to be solved by the invention]Thus, in which conventional example mentioned above, although carbon, such as SiO_2 and Si_3N_4, is used as a protective film of an organic EL device, the composition which laminates continuously the carbon film of two or more layers in which the film characteristics differ in these protective films is not described. Also in the conventional example which is making the carbon film cover, there is nothing on which high adhesion nature and high hardness (high-density) peculiar to a carbon film are made to act effectively. Therefore, total film thickness also including the ground film thickness of these protective films needs not less than several 10 nm.

[0006]Protective films of step coverage, such as conventional SiO_2 and Si_3N_4, are [the Reason] insufficient, and it is not precise. Even if it makes a carbon film cover, as long as this is a single layer film, if film adhesion is thought as important, the optimal film hardness will not be obtained, and if film hardness is thought as important on the contrary, the optimal film adhesion will not be acquired. Therefore, it is because the protective film with which it is satisfied of the both sides of film adhesion and film hardness is not obtained as long as it is a single layer film.

[0007]It is in providing an organic EL device with which this invention was made in view of the above-mentioned problem, and the main purpose had the adhesion nature and precise nature of enough films, and the thin protective film of film thickness was formed, and a manufacturing method for the same.

[0008]

[Means for solving problem]To achieve the above objects, in the 1st viewpoint, this invention, [on a substrate] They are a ground film and a protective film which laminates DLC (diamond like carbon) more than two-layer at least, A DLC layer stuck to said ground film formed in said substrate is formed by hydrogen part pressing down predetermined [that internal stress becomes small], At least one layer other than said DLC layer stuck to said ground film among said protective films is formed under conditions which do not contain substantially hydrogen that density becomes large.

[0009]This invention is a manufacturing method of a protective film which laminates DLC more than two-layer on a substrate at least with a ground film in the 2nd viewpoint, (a) A process of forming the 1st DLC layer stuck to said ground film formed in said substrate under conditions of 20% of hydrogen partial pressure abbreviation which becomes small [internal stress], (b) Include at least a process of forming hydrogen which becomes large [density] about the 2nd DLC layer under conditions which are not included substantially on said 1st DLC layer.

[0010]In an organic EL device with which a protective film is formed on said glass substrate so that an anode, an organic electroluminescence layer, and the negative pole may be laminated by this order on a glass substrate and this invention may cover these in the 3rd viewpoint, Said protective film makes a ground film which consists of amorphous silicone, and structure which laminated DLC more than two-layer at least, A layer stuck to said ground film formed in said glass substrate among protective films of said lamination structure is constituted by the 1st DLC layer with small internal stress, and at least one layer other than said 1st DLC layer is constituted by the 2nd DLC layer with large density.

[0011]In this invention, it is preferred that the thickness of said protective film is 10 nm or less, and it can also have composition of said protective film in which the above is further formed with hydrogenation carbon at least.

[0012]In this invention, said 1st DLC layer is formed under the conditions of 20% of hydrogen partial pressure abbreviation, said 2nd DLC layer is formed under the conditions which do not contain hydrogen substantially, and it is preferred that said 1st DLC layer or the 2nd DLC layer is the film formed of the CVD method or the sputtering method.

[0013][this invention] [on the glass substrate in which the (a) anode, an organic electroluminescence layer, and the negative pole were laminated by this order in the 4th viewpoint] The process of forming the 1st DLC layer after the ground film formation which consists of amorphous silicone under the conditions of 20% of hydrogen partial pressure abbreviation that stress becomes small, (b) Include at least the process of forming hydrogen that density becomes large about the 2nd DLC layer, under the conditions which are not included substantially on said 1st DLC layer.

[0014]

[Mode for carrying out the invention]In the desirable 1 embodiment, [the organic EL device concerning this invention] An anode (2 of drawing 1), an organic electroluminescence layer (3 of drawing 1), and the negative pole (4 of drawing 1) are laminated by this order on a glass substrate (1 of drawing 1), It is the organic EL device with which the DLC protective film (5 of drawing 1) is formed on the glass substrate so that these may be covered, A DLC protective film makes the ground film (6 of drawing 2) which consists of amorphous silicone, and the structure which laminated DLC more than two-layer at least, The 1st carbon protective film (7 of drawing 2) sticking to the ground film formed in the glass substrate among the lamination is formed by a CVD method or the sputtering method under the conditions of 20% of hydrogen partial pressure abbreviation that internal stress becomes small, The 2nd carbon protective film (8 of drawing 2) laminated on it is formed by the CVD method or the sputtering method under the conditions which do not contain substantially hydrogen that density becomes large.

[0015]For making a protective film of an organic EL device into such a structure, adhesion nature with the negative pole or a glass substrate can be protected by a small layer of internal stress, and an organic EL device can be protected from oxygen or moisture by a layer with precise nature high with slight height. Total film thickness can be made into a thin film of 10 nm or less by optimizing membrane formation conditions of each layer.

[0016]

[Working example]The above-mentioned embodiment of the invention is described below with reference to drawing 1 thru/or drawing 4 about an embodiment of this invention that it should explain still in detail. Drawing 1 is a sectional view for explaining typically structure of an organic EL device concerning one

embodiment of this invention.
Drawing 2 is a sectional view showing structure of a DLC protective film.
Drawing 3 is a figure showing stress of a DLC protective film, and a relation of hydrogen partial pressure.
Drawing 4 is a figure showing hardness of a DLC protective film, and a relation of hydrogen partial pressure.

[0017]As shown in drawing 1, [the organic EL device of this example] It is constituted by forming the anode (transparent electrode) 2 which consists of ITO(s) (indium tin oxidation thing) on the glass substrate 1 like a conventional example, and forming the organic electroluminescence layer 3 and negative pole 4 grades, such as an electron hole pouring transportation layer, a luminous layer, and an electronic pouring transportation layer, on this. The DLC protective film 5 is made to cover with this example for the corrosion control of a cathode part and an organic electroluminescence layer.
[0018]As shown in drawing 2, this DLC protective film 5 is an insulating film constituted by DLC, and is formed by a CVD method or the sputtering method at low temperature. A method for film deposition forms the amorphous Si film 6 as a ground film to the negative pole 4 first. At this time, before forming an amorphous Si film, a reverse sputtering may be given as a pretreatment, and the negative pole 4 surface may be cleaned.
[0019]Next, although the 1st carbon protective film 7 is formed, it is the feature that this 1st carbon protective film 7 forms membranes under the conditions from which hydrogen partial pressure will be abbreviated 20% (20 to 25%). The Reason is because stress of the DLC protective film 5 can be made the smallest, when membranes are formed under the conditions whose hydrogen partial pressure is abbreviated 20%, as shown in drawing 3 showing the hydrogen partial pressure at the time of DLC membrane formation, and the relation of stress (internal stress). That is, it is because exfoliation of the DLC protective film 5 can be controlled and adhesion nature with the glass substrate 1 or the negative pole 4 can be improved, if a membranous stress is small.
[0020]The 2nd carbon protective film 8 is formed and the carbon protective film of two layers is made to form on it. It is the feature that this 2nd carbon protective film 8 forms hydrogen under the conditions (for example, 0% of hydrogen partial pressure) which are not included substantially. This is because the direction which hydrogen partial pressure formed on few conditions can make the highest hardness (film density) of the DLC protective film 5, as shown in drawing 4 showing the relation of the hydrogen partial pressure and hardness (film density) at the time of DLC membrane formation. That is, it is because it will become can control that oxygen and moisture permeate a film and possible to make thin film thickness required as a protective film if the density of a film is high.
[0021]here -- an amorphous Si film -- about 1-2 nm, the 1st carbon protective film 7, and the 2nd carbon protective film 8 -- about 3 in all-8 nm -- with -- it is good, therefore is 10 nm or less as total as film thickness of a DLC protective film.
Compared with the former, it comprises a super-thin film.

[0022]Thus, in the composition of this example, stress raises adhesion nature with the negative pole with the 1st small good carbon protective film of step coverage, It can control that oxygen and moisture in the atmosphere penetrate to a cathode part and an organic electroluminescence layer with the 2nd carbon protective film with high hardness (film density) as much as possible. Therefore, though it is thin film

thickness compared with the former, it can fully function as a protective film.

[0023]In this example, although the example of two-layer structure was explained as a structure of a DLC protective film, this invention is not limited to the above-mentioned embodiment, and even if it laminates the hydrogenation carbon protective film of three or more layers, for example, it generates the same effect. This carbon protective film is formed by a CVD method or the sputtering method at low temperature.

[0024]

[Effect of the Invention]As explained above, according to this invention, also in a high-humidity/temperature environment, the corrosion of the cathode part by oxygen and moisture in the atmosphere and an organic electroluminescence layer can be controlled, therefore the life characteristic of an organic EL device improves, and the effect that long-term reliability can be acquired is generated.

[0025]Since the Reason is constituted by the 1st carbon protective film with a small stress and a DLC protective film of this invention good [step coverage], and the 2nd carbon protective film with a precise film, It is because it excels in adhesion nature with a substrate and a cathode part and an organic electroluminescence layer can be protected from oxygen and moisture in the atmosphere.

[0026]According to the composition of this invention, since a DLC protective film can be made to cover with a super-thin film of 10 nm or less, it also has the effect that a thin organic EL display can be provided.

[Brief Description of the Drawings]

[Drawing 1]It is a sectional view for explaining the structure of the organic EL device concerning one embodiment of this invention.

[Drawing 2]It is a sectional view for explaining the structure of the DLC protective film concerning one embodiment of this invention.

[Drawing 3]It is a figure for explaining the relation between the DLC protective film stress concerning one embodiment of this invention, and hydrogen partial pressure.

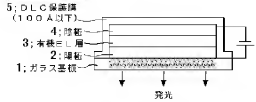
[Drawing 4]It is a figure for explaining the relation between the DLC protective film hardness concerning one embodiment of this invention, and hydrogen partial pressure.

[Drawing 5]It is a sectional view for explaining the conventional organic EL device.

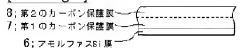
[Explanations of letters or numerals]

1 Glass substrate
2 Anode
3 Organic electroluminescence layer
4 Negative pole
5 DLC protective film
6 Amorphous Si film
7 1st carbon protective film
8 2nd carbon protective film
9 Protective film

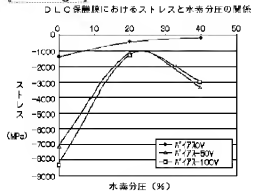
[Drawing 1]



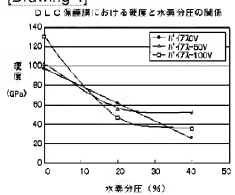
[Drawing 2]



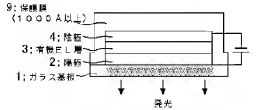
[Drawing 3]



[Drawing 4]



[Drawing 5]



---------- [Written Amendment]

[Filing date]Heisei 12(2000) February 14 (2000.2.14)

[Amendment 1]
[Document to be Amended]Description
[Item(s) to be Amended]Title of invention
[Method of Amendment]Change
[Proposed Amendment]
[Title of the Invention]Organic EL devices using a DLC protective film and this protective film, and those manufacturing methods
[Amendment 2]
[Document to be Amended]Description
[Item(s) to be Amended]Claims
[Method of Amendment]Change
[Proposed Amendment]
[Claim(s)]
[Claim 1]It is the DLC protective film which was laminated on insulating ground films other than a DLC (diamond like carbon) film formed on a substrate, and said ground film and which consists of a DLC film more than two-layer at least,
The 1st DLC film sticking to said ground film formed in said substrate is formed by hydrogen part pressing down predetermined [that internal stress becomes small],
A DLC protective film in which 2nd DLC film much more at least other than said 1st DLC film stuck to said ground film among said DLC protective films is characterized by what is formed under conditions which do not contain hydrogen substantially so that density may become large.
[Claim 2]The DLC protective film according to claim 1 in which said predetermined hydrogen partial pressure is characterized by what is been 25% or less not less than 20%.
[Claim 3]It is a manufacturing method of insulating ground films other than a DLC film, and a DLC protective film which laminates a DLC film more than two-layer on a substrate at least,
(a) A process of forming the 1st DLC film sticking to said ground film formed in said substrate under with a hydrogen partial pressure which becomes small [internal stress] not less than 20% 25% or less conditions,
(b) A manufacturing method of a DLC protective film including at least a process of forming hydrogen under conditions which are not included substantially on said 1st DLC film so that density may become large about the 2nd DLC film.
[Claim 4]In an organic EL device with which a DLC protective film is formed on said glass substrate so that an anode, an organic electroluminescence (electro-luminescence) layer, and the negative pole may be laminated by this order on a glass substrate and these may be covered,
Said DLC protective film consists of a DLC film which was laminated on a ground film which consists of amorphous silicone, and said ground film and which is more than two-layer at least,
An organic EL device with which 2nd DLC film much more at least other than said 1st DLC film that sticks a DLC film more than two-layer at least to said ground film, and said 1st DLC film is characterized by what it laminates in this order and is constituted.
[Claim 5]In an organic EL device with which a DLC protective film is formed on said glass substrate so that an anode, an organic electroluminescence layer, and the negative pole may be laminated by this order on a glass substrate and these may be covered,

Lamination structure which said DLC protective film laminated on a ground film which consists of amorphous silicone, and said ground film and which consists of a DLC film more than two-layer at least is made,
The 1st DLC film sticking to said ground film formed in said glass substrate among DLC protective films of said lamination structure is constituted by small DLC film of internal stress,
An organic EL device characterized by what 2nd DLC film much more at least of the DLC films more than two-layer [said] and other than said 1st DLC film is constituted for by DLC film with large density.
[Claim 6]The organic EL device according to claim 4 or 5 characterized by what thickness of said DLC protective film is 10 nm or less.
[Claim 7]The organic EL device according to claim 4 to 6 further characterized by what is formed with a DLC film in which the above DLC film was formed by hydrogen part pressing down of said DLC protective film predetermined [that internal stress becomes small] at least.
[Claim 8]The organic EL device according to any one of claims 4 to 7 with which said 1st DLC film is characterized by what is formed under with a hydrogen partial pressure not less than 20% 25% or less conditions.
[Claim 9]The organic EL device according to any one of claims 4 to 8 characterized by what said 2nd DLC film is formed for under conditions which do not contain hydrogen substantially.
[Claim 10]The organic EL device according to any one of claims 4 to 9 characterized by what said 1st DLC film or the 2nd DLC film is a film formed by a CVD method.
[Claim 11]The organic EL device according to any one of claims 4 to 9 characterized by what said 1st DLC film or the 2nd DLC film is a film formed of a sputtering method.
[Claim 12](a) A process of sticking the 1st DLC film at said ground film under the with a hydrogen partial pressure not less than 20% 25% or less conditions that internal stress becomes small, and forming membranes after ground film formation which consists of amorphous silicone on a glass substrate in which an anode, an organic electroluminescence layer, and the negative pole were laminated by this order,
(b) A manufacturing method of an organic EL device characterized by what a process of forming hydrogen under conditions which are not included substantially on said 1st DLC film so that density may become large about the 2nd DLC film is included for at least.
[Claim 13]A manufacturing method of the organic EL device according to claim 12 characterized by what said 1st DLC film or said 2nd DLC film is formed for with a CVD method.
[Claim 14]A manufacturing method of the organic EL device according to claim 12 characterized by what said 1st DLC film or said 2nd DLC film is formed for by a sputtering method.
[Amendment 3]
[Document to be Amended]Description
[Item(s) to be Amended]0001
[Method of Amendment]Change
[Proposed Amendment]
[0001]
[Field of the Invention]This invention relates to the organic EL devices which have a DLC protective film possessing the DLC film especially formed by predetermined hydrogen part pressing down, and this protective film, and those manufacturing methods about the organic electroluminescence (electro-luminescence) elements which used the DLC protective film and this protective film, and those

manufacturing methods.
[Amendment 4]
[Document to be Amended]Description
[Item(s) to be Amended]0005
[Method of Amendment]Change
[Proposed Amendment]
[0005]
[Problem to be solved by the invention]Thus, in which conventional example mentioned above, although DLC films, such as SiO_2 and Si_3N_4, are used as a protective film of an organic EL device, the composition which laminates continuously the DLC film of two or more layers in which the film characteristics differ in these protective films is not described. Also in the conventional example which is making the DLC film cover, there is nothing on which high adhesion nature and high hardness (high-density) peculiar to a DLC film are made to act effectively. Therefore, total film thickness also including the ground film thickness of these protective films needs not less than several 10 nm.
[Amendment 5]
[Document to be Amended]Description
[Item(s) to be Amended]0006
[Method of Amendment]Change
[Proposed Amendment]
[0006]Protective films of step coverage, such as conventional SiO_2 and Si_3N_4, are [the Reason] insufficient, and it is not precise. Even if it makes a DLC film cover, as long as this is a single layer film, if film adhesion is thought as important, the optimal film hardness will not be obtained, and if film hardness is thought as important on the contrary, the optimal film adhesion will not be acquired. Therefore, it is because the protective film with which it is satisfied of the both sides of film adhesion and film hardness is not obtained as long as it is a single layer film.
[Amendment 6]
[Document to be Amended]Description
[Item(s) to be Amended]0007
[Method of Amendment]Change
[Proposed Amendment]
[0007]It is in providing the organic EL devices with which this invention was made in view of the above-mentioned problem, and the main purpose had the adhesion nature and precise nature of enough films, and the thin DLC protective film and this protective film of film thickness were formed, and those manufacturing methods.
[Amendment 7]
[Document to be Amended]Description
[Item(s) to be Amended]0008
[Method of Amendment]Change
[Proposed Amendment]
[0008]

[Means for solving problem]To achieve the above objects, this invention is a DLC protective film which was laminated in the 1st viewpoint on insulating ground films other than the DLC (diamond like carbon) film formed on the substrate, and said ground film and which consists of a DLC film more than two-layer at least, The 1st DLC film sticking to said ground film formed in said substrate is formed by hydrogen part pressing down predetermined [that internal stress becomes small],2nd DLC film much more at least other than said 1st DLC film stuck to said ground film among said DLC protective films is formed under the conditions which do not contain hydrogen substantially so that density may become large.

[Amendment 8]

[Document to be Amended]Description

[Item(s) to be Amended]0009

[Method of Amendment]Change

[Proposed Amendment]

[0009]This invention is a manufacturing method of the DLC protective film which laminates the DLC film more than two-layer on a substrate at least with insulating ground films other than a DLC film in the 2nd viewpoint, (a) The process of forming the 1st DLC film sticking to said ground film formed in said substrate under with a hydrogen partial pressure which becomes small [internal stress] not less than 20% 25% or less conditions, (b) Include at least the process of forming hydrogen under the conditions which are not included substantially on said 1st DLC film so that density may become large about the 2nd DLC film.

[Amendment 9]

[Document to be Amended]Description

[Item(s) to be Amended]0010

[Method of Amendment]Change

[Proposed Amendment]

[0010]In the organic EL device with which the DLC protective film is formed on said glass substrate so that an anode, an organic electroluminescence layer, and the negative pole may be laminated by this order on a glass substrate and this invention may cover these in the 3rd viewpoint, said DLC protective film laminated on the ground film which consists of amorphous silicone, and said ground film -- consisting of a DLC film more than two-layer at least -- said, [the DLC film more than two-layer at least] 2nd DLC film much more at least other than the 1st DLC film sticking to said ground film and said 1st DLC film laminates in this order, and is constituted. In the organic EL device with which the DLC protective film is formed on said glass substrate so that an anode, an organic electroluminescence layer, and the negative pole may be laminated by this order on a glass substrate and this invention may cover these in the 4th viewpoint, The lamination structure which said DLC protective film laminated on the ground film which consists of amorphous silicone, and said ground film and which consists of a DLC film more than two-layer at least is made, The 1st DLC film sticking to said ground film formed in said glass substrate among the DLC protective films of said lamination structure is constituted by the small DLC film of internal stress, 2nd DLC film much more at least of the DLC films more than two-layer [said] and other than said 1st DLC film is constituted by the DLC film with large density.

[Amendment 10]

[Document to be Amended]Description

[Item(s) to be Amended]0011

[Method of Amendment]Change
[Proposed Amendment]
[0011]In this invention, it is preferred that the thickness of said DLC protective film is 10 nm or less, and it can also have composition currently formed with the DLC film formed by predetermined hydrogen part pressing down of said DLC protective film whose internal stress becomes small further at least in the above DLC film.
[Amendment 11]
[Document to be Amended]Description
[Item(s) to be Amended]0012
[Method of Amendment]Change
[Proposed Amendment]
[0012]In this invention, said 1st DLC film is formed under with a hydrogen partial pressure not less than 20% 25% or less conditions, Said 2nd DLC film is formed under the conditions which do not contain hydrogen substantially, and it is preferred that said 1st DLC film or the 2nd DLC film is a film formed of the CVD method or the sputtering method.
[Amendment 12]
[Document to be Amended]Description
[Item(s) to be Amended]0013
[Method of Amendment]Change
[Proposed Amendment]
[0013][this invention] [on the glass substrate in which the (a) anode, an organic electroluminescence layer, and the negative pole were laminated by this order in the 5th viewpoint] The process of sticking the 1st DLC film to said ground film under the with a hydrogen partial pressure not less than 20% 25% or less conditions that internal stress (stress) becomes small, and forming membranes after the ground film formation which consists of amorphous silicone,(b) Include at least the process of forming hydrogen under the conditions which are not included substantially on said 1st DLC film so that density may become large about the 2nd DLC film.
[Amendment 13]
[Document to be Amended]Description
[Item(s) to be Amended]0014
[Method of Amendment]Change
[Proposed Amendment]
[0014]
[Mode for carrying out the invention]In the desirable 1 embodiment, [the organic EL device concerning this invention] An anode (2 of drawing 1), an organic electroluminescence layer (3 of drawing 1), and the negative pole (4 of drawing 1) are laminated by this order on a glass substrate (1 of drawing 1), It is the organic EL device with which the DLC protective film (5 of drawing 1) is formed on the glass substrate so that these may be covered, A DLC protective film makes the ground film (6 of drawing 2) which consists of amorphous silicone, and the structure which laminated the DLC film more than two-layer at least, The 1st DLC film (7 of drawing 2) sticking to the ground film formed in the glass substrate among the lamination is formed by a CVD method or the sputtering method under the with a hydrogen partial pressure not less than

20% 25% or less conditions that internal stress becomes small, The 2nd DLC film (8 of drawing 2) laminated on it is formed by the CVD method or the sputtering method under the conditions which do not contain hydrogen substantially so that density may become large.

[Amendment 14]

[Document to be Amended]Description

[Item(s) to be Amended]0015

[Method of Amendment]Change

[Proposed Amendment]

[0015]With [the DLC protective film of an organic EL device] such a structure, the DLC protective film can protect adhesion nature with the negative pole or a glass substrate with the 1st DLC film with small internal stress, and can protect an organic EL device from oxygen or moisture with the 2nd DLC film with precise nature high with slight height. Total film thickness can be made into a thin film of 10 nm or less by optimizing the membrane formation conditions of each DLC film.

[Amendment 15]

[Document to be Amended]Description

[Item(s) to be Amended]0016

[Method of Amendment]Change

[Proposed Amendment]

[0016]

[Working example]The above-mentioned embodiment of the invention is described below with reference to drawing 1 thru/or drawing 4 about the embodiment of this invention that it should explain still in detail.

Drawing 1 is a sectional view for explaining typically the structure of the organic EL device using the DLC protective film concerning one embodiment of this invention.

Drawing 2 is a sectional view showing the structure of a DLC protective film.

Drawing 3 is a figure showing the stress of a DLC protective film, and the relation of hydrogen partial pressure (hydrogen partial pressure at the time of forming the 1st DLC film in said DLC protective film).

Drawing 4 is a figure showing the hardness of a DLC protective film, and the relation of hydrogen partial pressure (hydrogen partial pressure at the time of forming the 2nd DLC film in said DLC protective film).

[Amendment 16]

[Document to be Amended]Description

[Item(s) to be Amended]0018

[Method of Amendment]Change

[Proposed Amendment]

[0018]As shown in drawing 2, this DLC protective film 5 is an insulating film constituted with the 2nd DLC film 8 laminated on the amorphous Si film 6 which is an insulating ground film, the 1st DLC film 7 laminated on said amorphous Si film, and said 1st DLC film.

Membranes are formed by a CVD method or the sputtering method at low temperature.

A method for film deposition forms the amorphous Si film 6 as an insulating ground film to the negative pole 4 first. At this time, before forming an amorphous Si film, a reverse sputtering may be given as a pretreatment, and the negative pole 4 surface may be cleaned.

[Amendment 17]
[Document to be Amended]Description
[Item(s) to be Amended]0019
[Method of Amendment]Change
[Proposed Amendment]
[0019]Next, although the 1st DLC film 7 is formed, it is the feature that this 1st DLC film 7 forms membranes under the conditions from which hydrogen partial pressure will be 25% or less not less than 20%. This is because stress of the DLC protective film 5 can be made the smallest when hydrogen partial pressure forms the 1st DLC film 7 under not less than 20% 25% or less of conditions as shown in drawing 3 showing the hydrogen partial pressure at the time of membrane formation of the 1st DLC film, and the relation of the stress (internal stress) of the DLC protective film 5. That is, it is because exfoliation of the DLC protective film 5 can be controlled and adhesion nature with the glass substrate 1 or the negative pole 4 can be improved, if the stress of a DLC protective film is small.
[Amendment 18]
[Document to be Amended]Description
[Item(s) to be Amended]0020
[Method of Amendment]Change
[Proposed Amendment]
[0020]The 2nd DLC film 8 is formed and the DLC film of two layers is made to form on it. It is the feature that this 2nd DLC film 8 forms hydrogen under the conditions (for example, 0% of hydrogen partial pressure) which are not included substantially. This is because the direction which hydrogen partial pressure formed on few conditions can make the highest hardness (film density) of the DLC protective film 5, as shown in drawing 4 showing the relation between the hydrogen partial pressure at the time of membrane formation of the 2nd DLC film, and the hardness (film density) of the DLC protective film 5. That is, it is because it will become can control that oxygen and moisture permeate the 2nd DLC film, and possible to make thin film thickness required as a DLC protective film if the density of the 2nd DLC film is high.
[Amendment 19]
[Document to be Amended]Description
[Item(s) to be Amended]0021
[Method of Amendment]Change
[Proposed Amendment]
[0021]here -- an amorphous Si film -- about 1-2 nm, the 1st DLC film 7, and the 2nd DLC film 8 -- about 3 in all-8 nm -- with -- it is good, therefore is 10 nm or less as total as film thickness of a DLC protective film. Compared with the former, it comprises a super-thin film.

[Amendment 20]
[Document to be Amended]Description
[Item(s) to be Amended]0022
[Method of Amendment]Change
[Proposed Amendment]
[0022]Thus, in the composition of this example, stress raises the adhesion nature of a DLC protective film

and the negative pole with the 1st small good DLC film of step coverage, It can control that oxygen and moisture in the atmosphere penetrate to a cathode part and an organic electroluminescence layer with the 2nd DLC film with high hardness (film density) as much as possible. Therefore, though it is thin film thickness compared with the former, it can fully function as a DLC protective film.

[Amendment 21]

[Document to be Amended]Description

[Item(s) to be Amended]0023

[Method of Amendment]Change

[Proposed Amendment]

[0023]Although the DLC film explained the example of two-layer structure as a structure of a DLC protective film by this example, This invention is not limited to the above-mentioned embodiment, and even if it laminates the DLC film (the same thing as the 1st DLC film 7) of three or more layers between the amorphous Si film 6 and the 2nd DLC film 8, for example, it generates the same effect. This 1st DLC film is formed by a CVD method or the sputtering method at low temperature.

[Amendment 22]

[Document to be Amended]Description

[Item(s) to be Amended]0025

[Method of Amendment]Change

[Proposed Amendment]

[0025]The Reason The ground film of insulation [protective film / of this invention / DLC] other than a DLC film, Are the DLC protective film which was laminated on said ground film and which consists of a DLC film more than two-layer at least, and Said 1st DLC film with a stress the DLC film more than two-layer sticks to said ground film, and small, and step coverage good at least, It is because it is constituted by 2nd precise DLC film much more at least other than said 1st DLC film, so it excels in adhesion nature with a substrate and a cathode part and an organic electroluminescence layer can be protected from oxygen and moisture in the atmosphere.

[Amendment 23]

[Document to be Amended]Description

[Item(s) to be Amended]Brief explanation of the drawings

[Method of Amendment]Change

[Proposed Amendment]

[Brief Description of the Drawings]

[Drawing 1]It is a sectional view for explaining the structure of the organic EL device using the DLC protective film concerning one embodiment of this invention.

[Drawing 2]It is a sectional view for explaining the structure of the DLC protective film concerning one embodiment of this invention.

[Drawing 3]It is a figure for explaining the relation between the stress in the DLC protective film concerning one embodiment of this invention, and hydrogen partial pressure (hydrogen partial pressure at the time of forming the 1st DLC film in said DLC protective film).

[Drawing 4]It is a figure for explaining the relation between the hardness in the DLC protective film concerning one embodiment of this invention, and hydrogen partial pressure (hydrogen partial pressure at

the time of forming the 2nd DLC film in said DLC protective film).

[Drawing 5]It is a sectional view for explaining the conventional organic EL device.

[Explanations of letters or numerals]

1 Glass substrate

2 Anode

3 Organic electroluminescence layer

4 Negative pole

5 DLC protective film

6 Amorphous Si film

7 1st DLC film

8 2nd DLC film

9 Protective film

[Amendment 24]

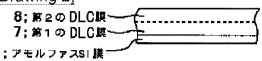
[Document to be Amended]DRAWINGS

[Item(s) to be Amended]Drawing 2

[Method of Amendment]Change

[Proposed Amendment]

[Drawing 2]



[Translation done.]